REMARKS

1. Claims 1-50 were pending. Claims 1, 6, and 23 has been amended. No claims have been added. No claims have been cancelled. No new matter has been added. Claims 1-50 are now pending. Reexamination and reconsideration of the application, as amended, are requested.

2. Rejection of Claims 1-5 under 35 U.S.C. §103(a)

Claims 1-5 were rejected under 35 U.S.C. 103(a) as being unpatentable over Tsujido et al. (5,471,565) in view of Takahashi (6,018,423).

The Applicant respectfully traverses the rejection and requests consideration of the following.

The teaching of Tsujido et al. requires that surfaces of an object are shaded prior to rendering (See Abstract, lines 8-12; Col. 3, lines 31-36; and Col. 3, lines 42-48 with respect to Fig. 7). Consequently, Tsujido et al. cannot be read to teach the following limitations recited in claim1 (emphasis added):

> "*rendering an image of the plurality of reflection points* at a plurality of positions with respect to the axis such that each said point maps an elongate, continuous image";
>
> "moving a semitransparent plane including a plurality of reflection points";
>
> "moving a semitransparent plane including a plurality of reflection points relative to an axis";
>
> "each said point maps an elongate, continuous image"

The Office Action points out that Tsujido et al. "teaches a rotary object having mirror surface (fig. 3) and does not teach a semitransparent plane". The limitations recited in claim 1 set forth that the "plurality of reflection points" are included in the "semitransparent plane". As such, Tsujido et al. teach use of a physical object (e.g., a

mirror). Conversely, Applicant's semitransparent plane that includes a plurality of points is a rendering concept that does not use the physical object of a mirror.

The Office Action points out that Takahashi also teaches use of the physical object of a mirror ("a mirror semitransparent plane mirror"). As noted above, the "semitransparent plane" including a "plurality of points" as recited in claim 1 is a rendering concept that does not use the physical object of a mirror. As such, none of the limitations of claim 1 could be read on the physical object embodied by the mirror taught in both of the applied references. For this reason, the rejection of claims 1-5 should be withdrawn.

In addition to the foregoing, teaching of Takahashi is non-analogous to Applicant's rendering teaching in that the teaching of Takahashi is directed towards an optical apparatus and an ocular optical system that is not being claimed by the present application.

Given the foregoing, neither Tsujido et al. nor Takahashi teach the limitations of claim 1. As such, claim 1 is allowable as are claims 2-7 that depend from claim 1.

3. <u>Rejection of Claims 6-7 under 35 U.S.C. §103(a)</u>

Claims 6 and 7 were rejected under 35 U.S.C. 103(a) as being unpatentable over Tsujido et al. (5,471,565) in view of Takahashi (6,018,423) and further in view of Grölier et al. "Modeling and Visualization of Knitwear", IEEE 1995, pages 302-310 (hereinafter "Grölier et al.").

The Applicant respectfully traverses the rejection and respectfully requests withdrawal of the rejection based upon the foregoing discussion regarding Tsujido et al. and Takahashi.

4. Rejection of Claims 8-32 and 36-46 under 35 U.S.C. §103(a)

Claims 8-32, 36-46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grölier et al. in view of Westin et al. "Predicting Reflectance Functions from Complex Surfaces", ACM published 1992 (hereinafter "Westin").

Claims 33, 47 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grölier et al. in view of Westin, and further in view of Neyret "Modeling, Animating, and Rendering Complex Scene Using Volumetric Textures", IEEE, 1998, pages 55-70) (herein after "Neyret").

Claims 34, 35 and 49, 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grölier et al. in view of Westin, and further in view of Neyret and Hanrahan "Reflection from Layered Surfaces due to Subsurface Scattering", ACM 1993, pages 165-174.

The Applicant respectfully traverses the rejections and requests consideration of the following.

Applicant teaches implementations for generating an individual yarn. The individual yarn is generated with a semitransparent microstructure defined by a planar plurality of reflection points. Stated otherwise, the semitransparent microstructure defined by a planar plurality of reflection points is a semitransparent lumislice. To generate the yarn, the plane is moved along an axis. The movement of the reflection points of the plane generate seemingly countless thin fibers when the generated yarn is closely examined. These thin fibers give the resultant yarn a fuzzy appearance. The individually rendered fuzzy yarns are applied to a macrostructure that assumes the form of knitwear. A close-up view of the resultant computer rendered knitwear shows that it is composed of fuzzy yarn fibers.

By generating knitwear from individually generated yarns that are applied to a macrostructure of the knitwear, Applicant's implementations can render knitwear appearing to be composed of complex stitches. Applicant's teaching also enables rendered knitwear to have a non-planar surface and to have a deformable surface.

Rather than generating individual yarns, Grölier et al. use a volume-rendering technique. As a consequence of the volume-rendering technique of Grölier et al., the resultant rendered knitwear can only be depicted as lying flat and will not have a free-form appearance. Moreover, Grölier et al. do not teach a technique that give individual yarns a fuzzy appearance. Also, Grölier et al. do not teach a technique that will give the resultant rendered knitwear to be made of fuzzy yarn fibers.

The foregoing differences between Grölier et al. and the teaching of the Applicant are underscored by Section VI "Conclusion and Summary of the Grölier et al. reference at Page 310 (emphasis added):

> We presented a novel technique for modeling the 3D-shape of knitwear. Our methods compare favorably with previous approaches which are based on 2D texture mapping of scanned textiles. Our method allows an explicit and flexible control of the yarn and the entire knitted fabric. Efficient rendering techniques enable a fast virtual design and rapid prototyping with high-quality representation of the results.
>
> *Future work will include mapping of knitted fabrics onto free-form surfaces. Positioning of knitwear onto a geometric model* of, e.g., a display dummy will further facilitate virtual design of textiles. *Obviously, the rendering technique described in Section IV will not be proper for all views of a free-form surface. For a close-up view, the rendering is still efficient since only a few basic elements have to be displayed. For views from farther away our approach can be used to generate realistic 2D textures* and can then be combined with standard texture mapping techniques.
>
> *We will look into more complex knitted stitch types* as well. Increasing the number of possible knitted stitch types should enable us to visualize more complex knitted fabrics like cable and chain stitches.
>
> The capabilities of modeling yarn structures within basic elements will be augmented to allow varying yarn thickness and to include special effects yarns like knotted yarns, bouclé yarns, and higher level yarns consisting of differently colored subyarns. Furthermore, we will have to

> address the visualization of boundary regions of knitted fabrics and the visualization of seams when joining together different pieces of knitwear.
>
> The physical simulation of knitwear is still very much an open problem. There has been some work done on physically simulating the drape of woven materials. *The more complex thread topology of knitting materials has so far apparently prevented similar work on the physical simulation of knitwear.* The location of a skeleton curve within a basic element depends on physical properties of the yarn structure, e.g. thickness and stiffness. Therefore, a physically accurate modeling of skeleton curves will have to be addressed as well.

From the foregoing, a conclusion is readily reached that Grölier et al. cannot be read to teach many of the elements recited in the independent claims, including but not limited to:

> Claim 8: "applying a semitransparent microstructure, defined by *planar plurality of reflection points*, to the macrostructure by *moving the plane of the reflection points with respect to each said axis* to yield a 3D model." (emphasis added)
>
> Claim 13: "applying a semitransparent *lumislice* to each said stitch pattern" (emphasis added)
>
> Claim 18: "applying *a yarn microstructure, defined by a planar plurality of reflection points*, to each stitch of the stitch pattern *applied to each axis defining the 3D object by rotating and translating the plane of the reflection points perpendicular with respect to each said axis* to yield a 3D knitwear model" (emphasis added)
>
> Claim 27: "each said voxel being semitransparent and having a reflectance factor and *a plurality of reflection points having a density*" (emphasis added)
>
> Claim 37 "applying a yarn microstructure, defined by a plurality of voxels contained within parallel opposing planes, to the macrostructure by translating and rotating the plurality of voxels contained within parallel opposing planes perpendicular respectively along and about each stitch of the stitch pattern applied to each said axis, wherein each said voxel is *semitransparent and has a reflectance factor and a plurality of points having a density*" (emphasis added)
>
> Claim 45: "*applying a lumislice*, with respect to a resolution of the distance of the view of the scene and a sampling density, to each stitch of the stitch pattern of the sorted discretized yarn segments *by translating and rotating the lumislice perpendicular to and respectively along and about each stitch* of the

stitch pattern applied to the plurality of intersecting axes, wherein *the lumislice is semitransparent* and is computed from a fiber distribution of a yarn cross-section" (emphasis added)

The limitations noted to be missing from Grölier et al. are not supplied by the teachings of Westin. In particular, Westin teaches techniques for approximating bidirectional reflectance distribution functions (BRDFs). While woven fabrics can be adequately represented by specialized BRDF models, BRDF models cannot be used to represent knitwear. Knitwear is characterized by a macroscopic stitch structure that requires an explicit model of the knitting pattern and geometry. Additionally, realistic knitwear generation requires the generation of the complicated microstructure of yarn. As mentioned above, close examination of yarn reveals countless thin fibers which give knitwear a fuzzy appearance – which is not true for woven fabrics. Improper rendering of knitwear results in aliasing that causes a scene to look artificial. As such, no BRDF model provides for photorealistic synthesis of knitwear. According, Westin cannot be read to teach the limitations of the independent claims that are set forth above.

Given the foregoing, the obviousness rejections of independent claim 8, 13, 18, 27, 37, and 45 by applying Grölier et al. in view of Westin are improper and are respectfully requested to be withdrawn. As such, independent claims 8, 13, 18, 27, 37, and 45 are allowable, as are claims 9-12, 14-17, 19-26, 28-26, 38-44, and 46-60 which respectively depend from the independent claims.

5. <u>Conclusion</u>

The Applicant respectfully maintains that the present application is in condition for allowance. Reconsideration of the rejections and objections is requested. Allowance of Claims 1-50 at an early date is solicited. In the event that the Examiner finds any remaining impediment to a prompt allowance of this application that could be clarified by

a telephonic interview, the Examiner is respectfully requested to initiate the same with the undersigned attorney.

Dated this 19 day of November, 2003.

Respectfully submitted,

BRADLEY K. DESANDRO
Attorney for Applicant
Registration No. 34,521

LEE & HAYES PLLC
421 W. Riverside Avenue
Suite 500
Spokane, WA 99201
Telephone: (509) 324-9256 (Ext. 228)
Facsimile: (509) 323-8979